RESEARCH DESIGN & STANDARDS ORGANIZATION
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Document No.: T-53
Indian Railway Standard Specification for Ultrasonic Testing of Rails/Welds, Revised-2020

Amendment History:

S.No.	Amendment Date	Version	Reasons for Amendment
1	27.02.2006	1.0	First issue of Specification February-2006
2	11/23.10.2007	2.0	The provision pertaining to the coverage area of the rail head rationalized. Testing frequency of rails/welds changed. Operator certification provision changed. Provision of QAP for the agency/firm
3	23.10.2012	3.0	Outsourcing of USFD testing of welds Provision of USFD testing of outsourcing of welds.
4	10.06.2020	4.0	USFD testing of Rails in Track using B-Scan USFD machine.

1. Scope:

This specification applies to the through ultrasonic testing of rails/welds manually by SRT/DRT with B-Scan and ultrasonic testing by hand probing of Alumino Thermit (A.T), Flash butt (F.B) & Gas Pressure (G.P) rail welds in service by weld tester, to identify, locate and evaluate internal defects for track of Indian Railway. The specification is to be used for outsourcing of ultrasonic testing of rails/welds.

2. Definition of terms:

The terms and definitions used in this specification are placed in Annexure-1. The list is indicative and not exhaustive.

3. Technical Representative:

The Principal Chief Engineer (PCE) or his nominated technical representative shall be responsible for resolving technical issues, including interpretation or points of doubt with respect to the specification, which may arise from time to time. The decision of Principal Chief Engineer in such matters shall be final and binding.

4. Standards:

"Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips at the time of opening of the tender shall be the reference standard for classification of defects in rail/weld, detected during through ultrasonic testing manually by SRT/DRT with B-Scan and defects detected in A.T/ F.B/G.P rail welds during ultrasonic testing by hand probing. Wherever other standard(s) is/are referred in this specification, the revision of that standard current at the time of calling tenders shall be used. In case additional correction slips are issued to the Manual, during the pendency of the tender/contract, the test procedure/criteria shall have to be suitably updated.

5. USFD testing of rails & welds:

5.1 Rail defect definition: Rail and weld defects are classified and coded as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.2 Rail and Weld Defect testing:

5.2.1 Through Rail and Weld testing (Manually by SRT / DRT)

(a) Frequency: The agency/firm shall test the rails and welds during through Rail testing manually using SRT / DRT, in the track at locations and at intervals as directed by the Railway.

(b) Scanned Area: The equipment shall be capable of detecting defects originating within the area specified in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips for Through Rail and Weld testing manually by SRT / DRT**.**

5.2.2 Alumino Thermit (AT) welds testing by Hand Probing :

(a) Frequency: The agency / firm shall test Alumino thermit welds by hand probing using weld tester in the track at locations and at intervals as directed by the Railway.

(b) Scanned Area: The testing system shall be capable to detect the defects originating within the area specified in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.2.3 Flash-Butt (FB) / Gas Pressure welds testing (by hand probing):

(a) Frequency of testing of Flash Butt / Gas Pressure Welds: The agency/firm shall do ultrasonic test of the Flash Butt / Gas Pressure welds in the track at locations and at intervals as directed by the Railway.

(b) Scanned Area: The equipment shall be capable to detect the defects originating within the area specified in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips**.**

5.3 Sensitivity setting and Rail/ Weld defect classification

5.3.1 For through rail testing manually by SRT / DRT:

(a) Sensitivity Setting: The sensitivity setting of the USFD equipment shall be done with the help of standard test pieces as given in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

(b) Rail/ Weld defect classification: The defects in the rails/welds shall be classified as per the criteria given in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.3.2 For AT/FB/GP Weld defect classification (By hand probing):

(a) Sensitivity setting: The sensitivity setting of the USFD equipment shall be done with the help of standard test pieces as given in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

(b) Weld defect classification: The defects in welds shall be classified as per the criteria given in "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.4 Rail/Weld defect action requirements:

5.4.1 Rail and Weld defects (For through Rail testing manually by SRT / DRT): The action to be taken in respect of defective rails / welds detected during through pedestrian USFD testing shall be as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.4.2 Weld defects (by hand probing): The action to be taken for AT welds classified as defective (DFWO/DFWR) shall be as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.5 Defect identification requirements:

5.5.1 Rail and welds defects (For through Rail testing manually by SRT / DRT): Defect identification for Rail and weld defects by through rail testing manually by SRT/DRT shall be as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.5.2 Weld defects (By hand probing): Defect identification for weld defects by Hand probing shall be as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.5.3 Defect identification: Rail defects with respect to chainage of rails, GPS coordinates (Latitude & Longitude) and weld defects with respect to weld number shall be recorded. The defect shall also be marked and painted on both faces of rail/welds as per "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips.

5.5.4 Paint Quality: Paints used to mark defects shall be of the line marking type to meet the required colour density and adherence (to be durable in service). Paint used must remain adherent for a period of at least 3 months and painting technique used must ensure high visibility from a distance of thirty (30) meters. Paint used should be resistant to bubbling after application on rail that may be still wet with ultrasonic testing couplant.

6. Ultrasonic Testing Equipment and its Performance requirement:

6.1 Ultrasonic Testing Equipment: The agency /firm shall offer Ultrasonic Testing equipment for performance evaluation by RDSO as per Para 6.2 of this specification. M&C directorate shall only verify the performance of the equipment as per Para 6.2 of this specification.

Note:-

(a) Single Rail Tester (SRT) and Double Rail Tester (DRT) offered by agency / firm for performance evaluation by RDSO shall be capable of B-Scan recording with facility of location stamping in km/m/cm by digital encoder (odometer), GPS coordinates (latitude and longitude) recording. Equipment shall also have time stamping facility duly synchronized with GPS satellite clock on at least half hourly basis. Record of synchronization is to be stored in the equipment. In case signal is missing from satellite, real time clock in equipment shall record the time.

(b) The agency / firm has to submit the declaration that the echo pattern of their ultrasonic equipment shall not get disturbed under Electrified section of Indian Railways.

(c) The existing SRT / DRT without having B-Scan recording facility with remaining service life and having valid verification certificate, shall be included in the QAP in a separate list.

6.2 Ultrasonic Testing Equipment Performance requirement:

6.2.1 Testing Equipment: The equipment offered by the agency/firm shall meet the minimum detection levels commensurate with the provision of Para 5.1 to 5.4 as well as provisions of Para 9 of this specification.

6.2.1.1 The performance of each equipment shall be verified by Metallurgical & Chemical (M&C) Directorate of RDSO. After verification by performance evaluation, the verification certificate with unique number for each equipment will be issued by RDSO. This verification certificate will be valid for four years from the date of issue and after which, the equipment shall be offered for recertification before expiry of validity date. After re-verification of the equipment the validity will be assigned for the rest of the period of service life of USFD equipment which is 8 years. The service life i.e. 8 years is taken from the date of manufacture of the equipment.

6.2.1.2 The equipment offered by agency/firm and RDSO approved equipment available at M&C Dte will be calibrated to the same level of sensitivity on simulated flaws in the rail as prescribed in the "Manual for Ultrasonic Testing of Rails and Welds – Revised, 2012" along with its latest revision and updated correction slips for evaluation of performance. The equipment shall also be tested for coverage of rail section as per provision of clause 5.2.1 (b) / 5.2.2 (b) / 5.2.3 (b).

6.2.1.2 (a) The equipment under test shall exhibit equal or better coverage of rail/weld sections in detection of flaw as compared to the provisions of clause 5.2.1(b) / 5.2.2(b) / 5.2.3 (b).

6.2.1.2 (b) While testing rail pieces having natural defects, the equipment under test shall exhibit variation in echo vertical height and horizontal movement up to ±10%, when results are compared with signals of approved equipment available at M&C Dte.

6.2.1.3 M&C directorate will also check the, B-Scan recording capability with facility of location stamping in km/m/cm by digital encoder (odometer), GPS coordinate (latitude and longitude) recording and time stamping facility (duly synchronized with GPS satellite clock) for Single Rail Tester (SRT) and Double Rail Tester (DRT).

6.3 Standard Test Piece: The standard test pieces (as per Para 5.3 of this specification) meant for sensitivity setting of testing equipment should be verified by M&C Dte. of RDSO before the same is taken to field for sensitivity setting purpose. The validity of calibration certificate shall be 4 years from the date of issue, thereafter standard test pieces shall be offered subsequently for re-verification in every 4 years by the agency/firm. The validity after re-verification shall be assigned for next 4 years. The certificate of authenticity shall be issued with RDSO Stamp (Seal) to each standard test piece and the same stamp (Seal) shall be punched on each standard test piece.

6.4 Reliability of Defect Detection:

6.4.1 The reliability of detection of defects shall be verified by the Zonal Railways.

6.4.2 The reliability of detection of defects shall be 100%. However, due to variation in echo vertical height and horizontal movement up to specified level of ± 10 % **(Para 6.2.1.2(b)** of this specification**)**, the defect classification of defect may change accordingly.

6.4.3 This verification can be undertaken by use of either a rail containing artificial defects (if such a rail is available) or on a stretch of rail length containing OBS/OBSW/IMR/ IMRW/DFWO/DFWR defects. The testing shall be repeated at least three times to assess the reliability.

6.4.4 For reliability of defect detection, the probes of the equipment used by the agency /firm shall be set to the same level of sensitivity as that of the approved ultrasonic equipment (make and model approved by RDSO).

6.4.5 The equipment of agency/firm shall detect all those defects which are detected by approved ultrasonic equipment (make and model approved by RDSO) in each round of testing. Any over reporting by agency/firm's equipment shall also be confirmed by Zonal Railways by either testing at higher gain or alternative methods such as side probing, pitch catch method, breaking open the defect etc.

7. Operator Certification and Other Requirements:

7.1 Agency/firm shall not employ any Ultrasonic operator, who does not hold valid competency certificate issued by RDSO as per Para 7.2. The operator shall possess original copy of the valid Competency Certificate issued by RDSO while performing through testing of rails & welds and /or USFD testing of welds by hand probing in the field and produce the same to railway officials when demanded. Railways shall put in place a mechanism to maintain day to day records of operators employed by the agency/firm along with equipment used (Sr. No. of machine etc.). Sectional ADEN/DEN/Sr. DEN (where testing is being done) shall verify the competency certificate of the USFD operator by matching with the one uploaded on relevant TMS application during their inspection.

7.2 Competency certificate issued by the RDSO: M&C directorate of RDSO issues competency certificate in following categories:

(a) Provisional competency certificate valid for 6 months for

- **(i)** Through Rail and Weld testing manually by SRT and DRT.
- **(ii)** USFD testing of welds by Hand probing only.

(b) Regular competency certificate valid for 2 years for

- **(i)** Through Rail and Weld testing manually by SRT and DRT.
- **(ii)** USFD testing of welds by Hand probing only.

Note:-

(i) The competency certificate (Provisional / Regular) will be uploaded on TMS by RDSO (Track Design Dte.) against the approved QAP of the agency/firm.

(ii) The existing competency certificate issued to the USFD operator by the M&C directorate for the A-Scan testing shall remain valid and shall be included in the QAP.

7.3 Operator training, examination and practical assessment: USFD operators to be deployed for through rail testing / weld testing should have attained a specified level of training and experience. The requirement for operator training, examination and practical assessment to obtain the desired level of certification is as under:

7.3.1 Provisional Competency Certificate:

(a) Academic qualification: The operator shall have minimum academic qualification of Bachelor in Science or equivalent with Physics as one of the subject from a University or Institution recognized by Central / State Government/ UGC/ International Institute / International University

or

Three years regular Diploma in Engineering in Mechanical / Civil / Electronics/ Electrical / Metallurgy / Chemical from a university or Institution recognised by Central / State Govt / Technical education board or International Institute / University.

or

M.Sc in Chemistry, provided that Physics was one of the subject at ISC/Intermediate / 10+2 level

or

BE/B.Tech Degree in Mechanical / Civil / Electronics/ Electrical / Metallurgy / Chemical/ I.T/Computer Science Engineering from a university or Institution recognized by Central / State Govt / Technical education board or International institute / university.

And

(b) The operator shall have a valid Level II certification in ultrasonic testing (UT) from any National/International Non destructive Testing Society /Institute/ Training Centre.

(c) Vision Requirement: The operators shall fulfill following requirements of vision:

- **(i)** Near Vision & Far Vision: The operator should have 6/6 vision with or without Spectacles.
- **(ii)** Colour Contrast Differentiation Test: The operator shall not be colour blind and shall be fit to distinguish the primary colour.
- **(iii)** The operator(s) appearing for RDSO certificate shall produce a certificate in this regard from a registered private Medical Practitioner / Eye-Specialist or from a Govt. Hospital.

(d) In addition to the fulfillment of requirements mentioned at (a), (b) & (c) above, the operator should have successfully attended & passed following examination /courses conducted by RDSO for Provisional Competency Certification:

- **(i) Through Rail and Weld testing:** The operator should have attended & passed the 2 days certification examination on 'Certification of Rail (Outsourcing)' of UST of Rails & Rail Welds organized by M&C Directorate, RDSO, Lucknow.
- **(ii) USFD testing of only welds by Hand probing**: The operator should have attended & passed the 5 days 'Course on UST of AT & FB welds (Only for weld) (Outsourcing)' organized by M&C Dte, RDSO, Lucknow.
- **(iii) USFD testing of welds (by Hand probing) for certified operator as per (i) above:** The operator should have Provisional/ Regular Competency Certification in Ultrasonic testing of Rail & Welds by SRT /DRT with B-Scan issued by M&C

Directorate, RDSO, Lucknow (This certificate shall be valid at the time of appearing in the orientation course) and should have attended and passed 03 days 'Orientation Course on UST of AT and FB welds (Outsourcing)' organized by M&C Directorate, RDSO, Lucknow.

7.3.2 Regular Competency Certificate: Regular Competency Certificate shall be valid for 2 years. The operator should have passed recertification examination (Recertification of Rail (Outsourcing) and/or Recertification of AT & FB Welds (Outsourcing)) organized by M&C directorate along with following qualifying criteria:

(a) For Regular Competency Certification in through testing of rail and weld manually by SRT/DRT (B-Scan): The operator holding provisional competency certificate shall have an experience of satisfactory performance in 'through manual USFD testing' of 100 Track Kms (200 rail Kms) under guidance of a regular competency certificate holder of the agency/firm or person heading agency/firm's quality control organization as defined in Clause 7.5 of this specification. The certification to this effect shall be from the officer-in-charge of the section (Asstt. Engineer or higher), from Indian Railways or from Metro Railways or from PSU's like KRCL, RVNL, MRVCL, DFCCIL, RITES, IRCON, where the operator has performed testing and same shall be submitted by agency /firm while applying for regular competency of operator.

(b) For regular competency certification in USFD testing of welds by hand probing: The operator holding provisional competency certificate shall have an experience of ultrasonic testing of 100 no. of rail weld joints satisfactorily under guidance of a regular competency certificate holder of the agency/firm or person heading agency/firm's quality control organization as defined in Clause 7.5 of this specification. The certification to this effect shall be from the officer-in-charge of the section (Asstt. Engineer or higher), from Indian Railways or from Metro Railways or from PSU's like KRCL, RVNL, MRVCL, DFCCIL, RITES, IRCON, where the operator has performed testing and same shall be submitted by agency /firm while applying for regular competency of operator.

(c) Alternatively, in case of Ex. USFD (of the rank of SSE and above) personnel of Indian Railways. The requirement shall be as under:

- The operator should have attended minimum 3 nos. of refresher courses conducted by the M&C Dte. of RDSO.
- The last such refresher course attended should not be more than 5 years earlier than the date of submission of QAP.
- The operator should have logged cumulative rail testing of at least 2000 Kms on Indian Railway.
- The operator should have attended & passed 5 days Course on UST of rails & welds, organized by M&C Directorate, RDSO, Lucknow.

(d) Vision Requirement: The suitability of vision of an operator in terms of Para 7.3.1 (c) above shall be got judged at the time of re-certification on the basis of documents submitted by the operators at M&C Dte/ RDSO.

7.3.3 **Re-issue of provisional certificate**:-The operator already holding provisional certificate but did not have requisite experience of through testing of rails and welds manually by SRT/DRT / or USFD testing of welds by hand probing as per clause 7.3.2 (a) or (b) above, The operators shall be considered for re-issue of provisional certificate valid for 6 months after passing examination conducted as mentioned in Para 7.3.1 (d) of this specification again by M&C Dte./RDSO/ Lucknow.

7.4 Quality Assurance Plan (QAP):

7.4.1 The agency/firm who wish to submit Quality Assurance Plan (QAP) for Ultrasonic Testing of Rail and welds or/and welds for outsourcing of USFD testing shall furnish the following information in the QAP, while submitting QAP to Track Design Directorate.

(i) Name of agency/ firm, registered address along with contact number & mailing address.

(ii) Registration certificate, details of GST registration, PAN number and ISO certificate.

(iii) Total Number of USFD machines:
- **(a)** For rail testing -SRT/DRT
- **(b)** For weld testing-weld tester.

(iv) Total number of operators:
- **(a)** For rail testing.
- **(b)** For weld testing.
- **(c)** For rail and weld testing both.

(v) QAP Incharge.

(vi) Details of IIW (V1) Blocks for calibration and standard test piece.

(vii) Self-assessed capacity: The self-assessed capacity shall be calculated as per following criteria
- **(a) For total no. of welds in a year**: One weld tester, two operators, 25 days of working in a month and 30 welds per day.
- **(b) For total Track Km in a year for SRT**: One SRT, two operators, 25 days of working in a month and 2 Track Km per day.
- **(c) For total Track Km in a year for DRT**: One DRT, two operators, 25 days of working in a month and 4 Track Km per day.

7.4.2 The agency/ firm shall prepare & submit QAP in four copies along with proof of charges deposited to RDSO for scrutiny of the QAP.

7.4.3 QAP shall be approved on the basis of verification of USFD machines, Certification of USFD operators & Quality Control Incharge and other information given by the agency/firm in Quality Assurance Plan. The details of USFD operator, verified USFD machines and standard test pieces mentioned in the QAP shall be examined by M&C Directorate. The list of approved QAP will be maintained by Track Design Directorate which will be uploaded at RDSO website and TMS. The validity of QAP shall be 3 years. After this period QAP shall be renewed based on the machines available with firms, operators qualified, performance of operators and other relevant factors.

7.5 Quality control Incharge: In order to have a proper implementation of QAP the agency/firm shall have a proper quality control organization headed by a Quality Control Incharge having minimum academic qualification as per Para 7.3.1 (a) and vision requirement as per Para 7.3.1 (c) of this specification. Quality Control Incharge shall be responsible for maintaining the operator training record and to undertake continuous monitoring of performance of all the operators. He shall be responsible to carry out the test checks of work done of all operators working under him. He shall insure that all operators have been imparted proper training for the duties assigned to them. The person should also have –

(i) Valid Level III certification in UT from any National/International Non destructive Testing Society or Institute/ Training Centre. In addition, he should have six months experience in Ultrasonic Testing of rails in any Railways of the world or shall have passed 5 days course in UT of Rails and Welds conducted by M&C Dte. of RDSO/Lucknow.

OR

(ii) Valid Level II certification in UT from any National/International Non destructive Society or Institute/ Training Centre. In addition, he should have minimum three year's experience in Ultrasonic Testing in any industry and shall also have valid certificate of Regular course for Ultrasonic Testing of rails/welds, conducted by M&C Dte. of RDSO/Lucknow.

OR

(iii) Any Ex. Indian Railways personnel of SSE level or above having minimum 10 years experience in USFD testing/ training/ standardization of USFD testing procedure for rails & welds. The USFD incharge should have attended & passed 5 days 'Course on UST of rails & welds, organized by M&C Directorate, RDSO, Lucknow.

Note:- The Quality Control in charge shall get himself trained and certified in SRT/DRT with B-Scan and will further train all the USFD operator working with him in the above B-Scan machines.

7.6 Status of QAP due to change of operator, Quality control Incharge, change in ownership of the firm etc

7.6.1 Operator wants to change the firm:

(a) The firm shall apply to M&C Directorate for the USFD operator who has joined his firm after leaving other firm with no objection certificate from previous firm and documents certifying the qualification as per Para 7 of the specification.

OR

(b) **(i)** The firm shall apply to M&C Directorate with a duly notarized affidavit on a non-judicial stamp of Rs.100/- executed by the operator, that he has applied for 'No Objection Certificate' from previous firm fifteen days in advance but previous firm has not issued no objection certificate and he has also no dues with the previous firm.

(ii) Operator shall also give an affidavit for any legal litigation raised by the previous firm, that will not have claim, for forfeiting his competency certificate by RDSO

till litigation is resolved between operator and previous firm. RDSO will not be responsible for any legal litigation/dispute between previous firm and/ or operator and previous firm and /or the firm where operator joins after leaving a firm.
The format for declaration by the operator is attached as Annexure-3

(c) M&C Directorate shall issue the modified competency certificate after taking charges as applicable for provisional or regular competency certificates as per nature of certificates held by the operator and no examination shall be taken for issuing the certificate. However, validity of the revised competency certificate shall be same as that of old competency certificate held by the operator. Such operator whose Competency Certificate is likely to expire or expired and they want to join another firm then they have to reappear and pass the relevant course and examination conducted by M&C Dte of RDSO to get the Competency Certificate in the name of new firm. The requisite charges shall be borne by firm in which operator joins after leaving the previous firm.

(d) There is no need to revise the QAP, irrespective of change in capacity of either or both firms. However, the firm whose operator has left the firm shall strike off the name of operator and other details from approved QAP and submit an authenticated copy of page of QAP in which name of operator and other details of operator has been struck off to M&C Dte. & Track Design Directorate, RDSO for record.

(e) The firm where operator has joined, shall intimate M&C Dte. & Track Design Directorate, RDSO about operator and other details of operator including the details of previous firm where the operator was previously working. An authenticated copy of page of QAP in which operator has been added shall be submitted to M&C Directorate and Track Design Directorate, RDSO for record.

(f) In case capacity of either or both firms get changed, the revised self-assessed capacity of the firm as mentioned in the specific pages of the respective QAP shall be submitted by the firm for review and verification by the RDSO. This information regarding revised self-assessed capacity shall be uploaded on RDSO website.

(g) QAP shall remain valid as per original validity.

7.6.2 Ownership of the firm is changed and firm name remains same and all the operators, equipment and quality control organization remains the same:

(a) Firm shall inform the change in ownership along with relevant documental proof to Track Design Directorate, RDSO.

(b) QAP shall remain valid in the name of the firm as per original validity.

7.6.3 Name of the firm is changed but ownership remains the same and all the operators, equipment and quality control organization remains the same:

(a) Firms shall submit the documental proof of changed name of the firm along with the request to Track Design & M&C Directorate, RDSO for other formalities.

(b) M&C Directorate shall issue the revised competency certificate for all the operators after taking charges as applicable for provisional or regular competency certificates as per nature of certificates held by the operators and for Quality Control Incharge after taking charges as applicable for Regular Course or 5 days course as the case may be. However,

no examination shall be taken for operators and Quality Control Incharge and validity of the modified competency certificate shall be same as that of old competency certificates.

(c) The firm shall approach M&C Directorate for re-verification of the ultrasonic equipment & standard test piece. The equipment shall be re-verified from M&C Directorate as per procedure given Para 6 of this specification. The service life of the equipment shall remain same as that in original verification certificate. Similarly, the validity of re-verified standard test piece will be assigned same as that in original verification certificate.

(d) Firm shall now submit the revised QAP and documents certifying the qualification for operators/quality control incharge as per Para 7 of the specification for approval.

(e) Revised QAP shall be valid for next three years, from the date of issuance of revised QAP, old QAP shall be treated as null and void.

7.6.4 Firm removes the operators:

(a) The firm shall inform the RDSO in writing regarding removal of operator with reason or leaving of operators himself.

(b) There is no need to revise the QAP, irrespective of change in capacity of firm. However, the name of the operators who have either left or removed from the firm along with their respective details shall also be removed from the QAP. An authenticated copy of page of QAP in which name of operators and other details of operators have been struck off shall be submitted to M&C Dte. & Track Design Directorate, RDSO for record.

(c) In case capacity of firm changed, the revised self-assessed capacity of the firm as mentioned in the specific pages of the QAP shall be submitted by the firm for review and verification by the RDSO. This information regarding revised self-assessed capacity shall be uploaded on RDSO website.

7.6.5 Change of quality control Incharge:

(a) The agency/firm shall inform the RDSO in advance regarding change of quality control Incharge.

(b) The agency/firm shall submit the revised QAP to RDSO for examination and approval. Old QAP shall remain valid during the revision of QAP only if firm gives the undertaking that the same quality control Incharge (as in Old verified QAP) shall work during the period of revision.

(c) Revised QAP shall be valid for next three years.

7.6.6 Firm transfer the USFD equipment (rail weld testers and standard test piece) to another firm.

(a) The agency/firm shall inform the RDSO in writing regarding transfer of USFD equipment to another firm.

(b) There is no need to revise the QAP, irrespective of change in capacity of either or both firms. However, the firm whose equipment and standard test piece has transferred shall remove the relevant details of equipment and standard test piece from QAP. An authenticated copy of page of QAP in which equipment and standard test piece has been

struck off shall be submitted to M&C Dte. & Track Design Directorate, RDSO for record.

(c) The agency/firm which is receiving the transferred equipment and standard test piece shall approach M&C Directorate for re-verification of the equipment by performance evaluation and verification of standard test piece. The transferred equipment shall be re-verified from M&C Directorate as per procedure given Para 6 of this specification. The service life of the equipment shall remain same as that in original verification certificate. Similarly, the validity of re-verified standard test piece will be assigned same as that in original verification certificate. An authenticated copy of page of QAP, in which details of equipment and standard test piece has been modified, shall be submitted to M&C Directorate and Track Design Directorate, RDSO for record.

(d) In case capacity of either or both firms changed, the revised self-assessed capacity of the firm, as mentioned in the specific pages of the respective QAP shall be submitted by the firm for review and verification by the RDSO. This information regarding revised self-assessed capacity shall be uploaded on RDSO website.

7.6.7 Addition/deletion of USFD equipment by the firm:

(a) The agency/firm shall inform the RDSO in writing regarding addition/deletion of USFD equipment by the firm.

(b) There is no need to revise the QAP, irrespective of change in capacity of firm. However, in case of deletion of USFD equipment, the relevant details of such equipment's shall be removed from the QAP. An authenticated copy of page of QAP in which equipment has been struck off shall be submitted to M&C Directorate and Track Design Directorate, RDSO for record.

(c) The agency/firm shall approach M&C Directorate for verification of the additional equipment. The additional equipment shall be verified from M&C Directorate as per procedure given Para 6 of this specification. An authenticated copy of page of QAP in which equipment has been added shall be submitted to M&C Directorate and Track Design Directorate, RDSO for record.

(d) In case capacity of firm changed, the revised self-assessed capacity of the firm as mentioned in the specific pages of the QAP shall be submitted by the firm for review and verification by the RDSO. This information regarding revised self-assessed capacity shall be uploaded on RDSO website.

Note:- Requisite charges will be raised by RDSO from the agency/firm for undertaking necessary changes as mentioned in Para 7.6 .

8. Test Checks:

8.1 Railways shall test check the capability of the operator and ultrasonic test system from time to time. These test checks can be carried out in accordance with clause 6.4 of this specification. The Railway reserves the right to test for any defect over a section of rail recently tested by agency/firm. Such test checks may be conducted over a section of track identified by Railway:

- Prior to the commencement of ultrasonic testing.

- Prior to the commencement of a ultrasonic testing after a change of operator and
- At completion of a predefined length of ultrasonic rail testing/ predefined number of ultrasonic welds testing as specified by the Zonal Railway.

8.2 The test results shall meet performance levels set out in Clause 6.4 of this specification.

8.3 Test check as specified by Railway shall be carried out.

8.4 The defects detected by agency/firm may be broke open by Railways for further analysis and to determine correctness of reporting. The percentage of such defects shall be as considered necessary by the Railway.

8.5 In case of Under-Reporting of IMR category defects in test check, repeat test of the corresponding complete stretch shall be carried out by the firm by the Manual USFD system (SRT/DRT). No additional payment would be made to the firm for such a repeat test.

9. Recording of Data:

9.1 The testing system of the agency /firm shall have minimum memory provision along with facility to entering and recording data as under

(a) For SRT:
- **(i)** 04 number Calibration Sets
- **(ii)** 200 A-Scan storage memory
- **(iii)** B-Scan recording facility

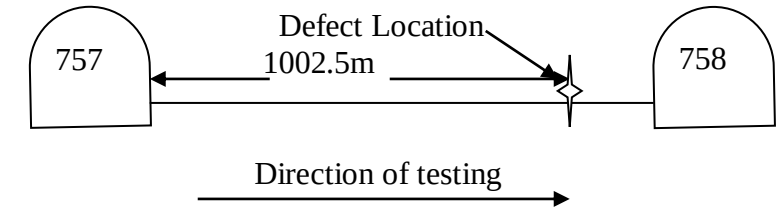
(b) For DRT:
- **(i)** 04 number Calibration Sets
- **(ii)** 400 A-Scan storage memory
- **(iii)** B-Scan recording facility

(c) For Weld Tester:
- **(i)** 04 number Calibration Sets

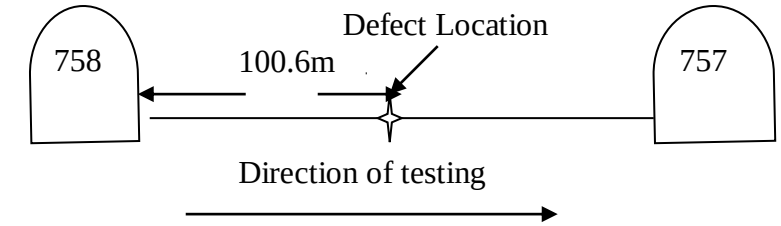
9.2 In order to overcome the problems associated with the long and short kilometers the defect location report shall indicate location references with respect to kilometer point and chainage as indicated below.

9.2.1 The location of defect shall be reported manually in 14 digit code comprising of

- first four digits for Km Post encountered first
- next four digits for Km post encountered next
- last six digits for chainage in meters.



Location of defect: 0757.0758.1002.50



Location of defect: 0758.0757.0100.60

9.2.2 Location of the defect shall also be indicated with reference to telegraph post/OHE mast numbers/ chainage. For SRT/DRT, location of defect in GPS coordinate (latitude and longitude) along with time stamping (equipment clock shall be duly synchronized with GPS satellite clock on at least half hourly basis, record of synchronization is to be stored in the equipment. In case signal is missing from satellite, real time clock on the equipment shall record the time.) shall also be recorded.

9.3 For SRT/DRT, the backup of ultrasonic testing data in electronic format shall be possible to be downloaded on desktop computer to allow analysis by suitable post processing software. Suitable post processing software shall be provided to Railway free of cost by the outsourcing agency/firm for analyzing recorded A-Scan, B-Scan data and recreation of A-Scan defect echo envelop display from B-Scan.

9.4 In case of ultrasonic testing of rails/welds by SRT/DRT, when a defect location is identified by the agency/firm's ultrasonic operators, the A-Scan defect echo envelope shall be recorded. Defect is marked in accordance with Para 5.5. Rails that have not been tested on turnouts and similar locations shall be recorded and reported.

9.5 If such circumstances arise in the test work (where the limitation on the capacity of the agency / firm's testing system to identify defects in specific common track situations actually prevents reliable testing), then the start and end points of these conditions which prevent reliable testing should be identified clearly in the test exception report and be annotated to the overall comments to field on the daily test report.

10. Documentation:

10.1 The agency/firm shall determine and record all information as specified below pertaining to Recording of Data with respect to the detection of rail flaw.

10.1.1 Daily test report gives a summary of the day's testing.

- Date of the inspection.
- Name of the operator.
- Name of Railway
- Name of Division
- Name of Block section
- The line tested: UP/DN/Single Line/NL/SL/3L/ 4L
- Chainage of start and finish of USFD testing as per Para 9.2.
- Section of Rail tested.
- Log of operating ultrasonic parameters for each run along with any changes and reasons e.g. change in gain due to temperature recalibration etc.
- Railways employee present during testing.
- Summary of all defects found during testing with chainage, defect classification and classification during the previous round of USFD testing if any.
- Comments field for notes on particular defects e.g.

  - The type, category, length and recommended action (e.g. paints).
  - In the case of flaws in welds whether thermit (TW), flash butt (FB)),gas pressure (GP) and whether the defect in the weld is in the head (H), web (W) or foot (F) of the rail.
  - The length and location of any rail/ weld that could not be tested for a particular reason.
  - Location of defect as Para 9.2.

10.1.2 Rail/ weld defect report listing all defects found during a test run.

- Running log of defects detected, peak pattern, category and defect echo envelope.
- Date of the inspection.
- Name of the operator.
- Name of Railway
- Name of Division
- Name of Block section
- The line tested: UP/DN/Single Line/NL/SL/3L/ 4L
- Chainage of start and finish of USFD testing as per Para 9.2.
- Location of defect as per Para 9.2.
- Classification of defect as per 'Manual for Ultrasonic Testing of Rails and Welds Revised, 2012' along with its latest revision and updated correction slips.
- In addition to above complete daily USFD test result shall be provided in the format matching with TMS for direct uploading of USFD test data on TMS (Track Management System). Format is provided at Annexure -2.

10.1.3 Priority defect list detailing rail defects requiring immediate action.

A priority defect report is to be communicated to the JE/SSE (P Way), immediately upon detecting IMR, IMRW and DFWO/DFWR rail defects requiring a speed restriction and removal (please refer Para 5.5).

10.1.4 Movement log detailing the daily location and hours spent testing.

Movement Reports shall contain sufficient information to enable identification of the actual kilometers tested during the course of the day, the railway corridor tested and all other information required to ascertain hours of testing involved, and any other performance issues deemed relevant for contract administration purposes.

This information must include the following: -

- Time of scheduled meeting of staff at test start point.
- Time of commencement of test.
- Location and chainage of commencement of test as per Para 9.2.
- Name of Block Section to be tested.
- The line tested: UP/DN/Single Line/NL/SL/3L/ 4L.
- Kilometers tested in each session.
- Time at which daily testing ceased.
- Location and chainage at which testing ceased as per Para 9.2.
- A comments field must indicate any areas by kilometer readings that could not be tested and the testing limitation which led to the lack of testing in this area.

10.1.5 Comparison report listing defects reported on consecutive test runs.

10.1.6 Rail/ weld test exception report which lists the sections of rail/ weld that are omitted from the test programme due to rail/ weld and track conditions.

10.2 The above reports shall be prepared in hard copy and shall be forwarded to the Junior Engineer (JE)/Sr.Section Engineer (SSE) (P.Way), AEN and DEN/ Sr. DEN. The report indicated in Para 10.1.1 and 10.1.2 shall be forwarded daily while the report indicated in Para 10.1.3 shall be communicated immediately to the above mentioned officials. All other reports shall be forwarded to JE /SSE (P.Way), AEN and DEN/Sr.DEN at the frequency decided by the DEN/Sr.DEN of the section.

10.3 The electronic report (Soft copy) shall also be provided by the agency/firm in Microsoft Word/Excel/Access format at the frequency decided by the DEN/Sr.DEN of the section.

10.4 The B-Scan data recorded by SRT/DRT (in electronic format) shall also be provided by the firm along with suitable software for viewing the results in the office of AEN, DEN/Sr.DEN of the section as mentioned in Para 9.3 of this specification.

Annexure -1

Definition

A-scan presentation: A form of display in rectangular coordinates, in which pulse amplitude is represented as a displacement on the vertical axis, and time is represented as a displacement on the horizontal axis. See Figure

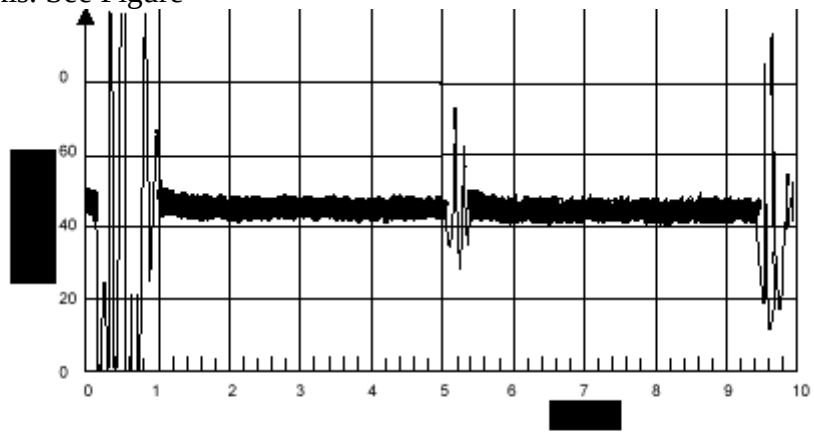


Figure 1.3(a). UNRECTIFIED A-SCAN DISPLAY

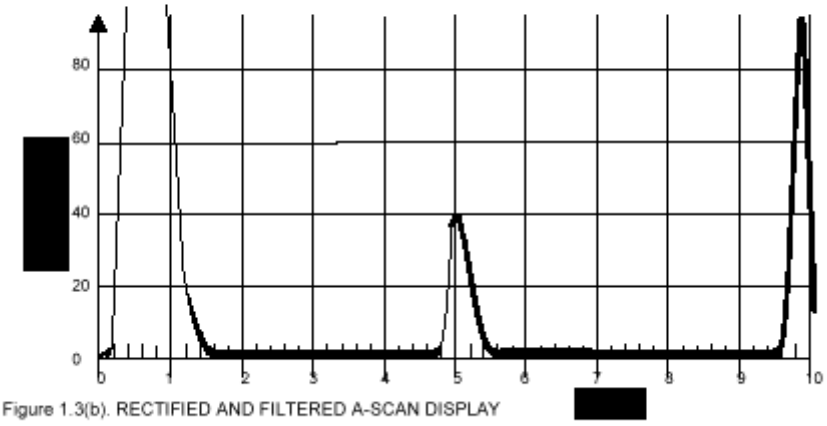


Figure 1.3(b). RECTIFIED AND FILTERED A-SCAN DISPLAY

Acoustic testing: The method of non-destructive testing which uses acoustic energy usually within the ultrasonic frequency range 1 MHz to 5 MHz.

Acoustic absorption: The component of ultrasonic wave attenuation resulting from ultrasonic energy being converted into heat energy.

Acoustic frequency: The number of oscillations per second experienced by a particle or point in a medium caused by the passage of an acoustic wave through it.

Acoustic shadow: The effect produced in a body by its geometry or by a discontinuity in it, whereby ultrasonic energy, when traveling in a particular direction is prevented from reaching a certain region within the body.

Angle probe: A contact probe by means of which ultrasonic waves can be introduced into a test object so that the beam axis is at an angle, other than 0° or 90°, to the perpendicular to the contact plane.

Approved ultrasonic equipment (make and model approved by RDSO): It is defined as the one which is supplied by RDSO approved supplier and meeting the testing requirements as per M&C specification (For SRT, DRT and weld tester RDSO/ M&C/NDT/128/2007 (B-Scan) Rev -III, July 2017, RDSO/ M&C/NDT/130/2007 (B-Scan) Rev -III, July 2017, RDSO/ M&C/NDT/129/2005, Rev -II, Aug 2014 along with their latest revision and updated correction slips.

Attenuation: The loss of acoustic energy within a medium due to scattering and absorption.

Automatic gain control (AGC): The means of automatically controlling the gain of the receiver amplifier in order to maintain a constant test sensitivity over a limited range.

B-scan presentation: The B-scan presentations is a profile view of the test specimen. In the B-scan, the time-of-flight (travel time) of the sound energy is displayed along the vertical axis and the linear position of the transducer is displayed along the horizontal axis

Back echo: An ultrasonic pulse reflected from the boundary of a body normal to the beam axis (eg back-wall echo).

Beam profile: The plot of the sound pressure distribution within the beam.

Beam spread: The solid angle which contains the main lobe of an ultrasonic beam in the far zone.

Calibration block: A piece of material of specified composition, heat treatment, geometric form and surface finish, by means of which the performance characteristics of ultrasonic equipment can be assessed and calibrated. (See also reference block)

Compression wave: A form of wave motion in any medium in which the particle displacement is parallel to the direction of propagation.

Compression wave probe: A probe for generating and/or receiving compression waves.

Couplant A medium interposed between two solids to assist the transfer of acoustic energy.

Critical angle: The incident angle of an ultrasonic signal at which a specified reflected or refracted mode ceases to exist.

Crystal (ultrasonic): Portion of a single crystal or polycrystalline sintered ceramic having piezo-electric properties, used for the generation and/or detection of ultrasonic energy.

Decibel (dB): A comparative measure of two signal amplitudes, obtained by multiplying by ten the common logarithm of the ratio of the power of the two signals:

$$dB = 10 \log_{10} \frac{[V1]^2}{[V2]} \quad \text{or} \quad 20 \log_{10} \frac{[V1]}{[V2]}$$

where: V1and V2 are the signal amplitudes.

Defect: A discontinuity whose size, shape, orientation, location or properties make it detrimental to the useful service of the product in which it occurs or which exceeds the accept/reject criteria for the given design.

Defect echo envelope: It is envelope of signals appearing on the screen in A-Scan for a particular probe for a particular defect.

Delay: The time interval between the transmission of a pulse and the initiation of the time base sweep.

Discontinuity: Any imperfection or interruption in the normal physical structure or configuration of a product, such as cracks, laps, seams, inclusions, porosity or laminations. A discontinuity may or may not affect the usefulness of the product.

Double crystal probe: A probe incorporating two acoustically separated crystals in a single housing, one of which acts as a transmitter of acoustic energy and the other as a receiver.

Double probe method: The use of one probe as a transmitter of acoustic energy and a second probe as the receiver.

Dynamic range: The difference in amplitude, measured in dB, between the largest and smallest signals of measurable height, which are capable of being simultaneously displayed in A-scan presentation.
NOTE: In A-scan presentation on a signal of height 2 mm is often taken as the smallest measurable signal. On this basis, if the largest measurable signal is of height 60 mm, and linearity of amplification is maintained over the full height of the display, the dynamic range would be: 20 log 30 = 20 × 1.477 = 29.54 = 29.5 dB.

Dead zone: The unusable portion of a display trace adjacent to the initial pulse indication due to the characteristics of the ultrasonic probe. (see also near zone, far zone).

Equivalent flat bottom hole: The flat bottom hole of a diameter such that, at a similar depth in a similar material to that of a discontinuity under evaluation, it most nearly provides equal reflectivity to that of discontinuity under similar test conditions.

Far zone: The region in an ultrasonic beam in which the intensity is inversely proportional to the square of the distance.

Gain: The amount by which the electrical signal from the ultrasonic transducer is amplified.

Gain control: An instrument control which enables the gain of a receiver to be adjusted; gain controls are usually calibrated in decibels.

Ghost echo: The display of remnant reflections resulting from a previously transmitted pulse due to the use of too high a pulse repetition frequency.

Grass: Background indications in A-scan presentation arising from material characteristics and/or equipment noise.

Indication: A response or evidence of a response in non-destructive testing that requires interpretation to determine its significance.

Interface: The boundary between two media of different acoustic impedance.

Magnetic induction: Use of an electric current to induct a magnetic field around a metal core.

Monitor: An electronic device for processing signals from a gated portion of the presentation.

Near zone: The region in an ultrasonic beam subject to variation of intensity due to interference effects. The length of the region is governed by frequency, probe diameter and material characteristics.

Noise: Acoustic or electrical interference arising from the amplifier, the probe or other sources.

Non-destructive testing/NDT: Testing of materials to detect internal, surface and concealed defects or discontinuities using methods which do not damage or destroy the material under test.

Normal probe: A probe so constructed that the beam axis is normal to the incident surface.

Overall system gain: The usable remaining gain expressed in decibels, when working at a given test sensitivity, i.e. when displaying as a signal of given height an echo from a given reflector.
NOTE: This may not be the total apparent amplification remaining since the introduction of electronic or probe noise to the display may limit amplification to be used.

Probe: An electro-acoustic device used for generating and/or receiving ultrasonic waves.

Probe index: The point on a shear wave or surface wave probe through which the axis of the emergent beam passes.

Probe shoe: Material interposed between a probe and test specimen to improve acoustic contact, to resist wear or as part of the construction of an angle probe.

Pulse: A short wave-train produced on each excitation of an electro-acoustic transducer.

Pulse echo method: A method by which a discontinuity is detected and evaluated by reflection of pulses.

Railway: Administrative units of Indian Railway including Railway board and Zonal Railways.

Reference block: A piece of material used as an aid to the interpretation of results (see also calibration block).

Resolution The ability of an ultrasonic flaw detection system to give separate indications of discontinuities having nearly the same range and/or lateral position with respect to the beam axis.

Scanning: The procedure of searching for discontinuities by movement of acoustic wave probes over the test surface which results in changes in the acoustic waves within the test object.

Sensitivity: The characteristics of an ultrasonic instrument and probe combination which determine the minimum usable input signal, i.e. the least input which after amplification and display satisfies certain specified requirements such as signal height.

Ultrasonic flaw detection/UFD: The testing technique utilizing acoustic technology to locate rail defects.

Wavelength: The distance in the direction of wave propagation, between successive wave fronts of identical phase.

Wedge: A prism, usually of plastic material, placed in acoustic contact between a crystal and the test object which causes ultrasonic waves to propagate at a known angle in that object.

Wheel probe: A mechanical device incorporating one or more crystals mounted inside a liquid filled flexible tyre.

Working sensitivity: A quantitative definition of the controllable variables which affect sensitivity, usually reported by reference to the signal height from a reference standard test piece and related instrument settings.

Annexure 2

Sr. No.	Date of Inspection	Division	Section	Line	Start km	End km	km tested	Operator Name	Machine no	km	Meter	LR/RR	Rail/Weld
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	DD/MM/YYYY				only numbers allowed	only numbers allowed	only numbers allowed			only numbers allowed	distance from km post (only numbers allowed)	LR (Left Rail) RR (Right Rail)	Rail Weld

Rail/Weld No.	Post From	Post To	Rolling Mark	Defect position	Prob Used	For 0 Degree Probe		Except 0 degree Probe (Shifting of Flaw)		Echo emp %	Defect Type	Joggeled	Any other Remark
						Depth (mm)	Length (mm)	From	to				
15	16	17	18	19	20	21	22	23	24	25	26	27	28
				H - Head W - Web F - Foot	Code - Description 0 - 0 37 - 37 45 - 45 46 - 45Tandem TR 70 - 70 71 - 70GF 72 - 70NGF 73 - 70Miniature 74 - 70SL							Y - Yes N - No	

Annexure-3

Format for Affidavit

I, *name of the USFD operator*……. S/o *Sri*……aged about…… Years, resident of……do hereby solemnly declare as under:

1. That I, deponent was working in …*name of previous agency/firm with address* and I have applied for 'No Objection Certificate' on … *date*…… from *name of previous agency/firm with address* and I have no dues to be deposited to *name of previous agency/firm* ……
2. That I, have now joined '*name of new agency/firm' with address* on *date*…….. In case of any legal litigation/dispute raise by *name of previous agency/firm with address*, RDSO reserves the right to forfeit my competency certificate.
3. I, also declare that in case of any legal litigation /dispute between previous agency/ firm and/ or me and previous firm and /or the other firm where I have joined, RDSO will not be party in any way for such cases and sole responsibility to tackle these cases will be mine or the other firm where I have joined.

Deponent

Verification

I, declare that the contents of Para 1 to 3 are true as per my knowledge and nothing has been hidden.

Deponent